Appendix E: Data Usability Assessment

Data usability is the process of evaluating the laboratory data results and determining the confidence with which any data point may be used. Data usability is evaluated to ensure that the opportunity for incorporating unacceptable and unmanageable error into the decision-making process is minimized to the extent possible. Usability is determined by evaluating the data qualifiers applied by the laboratory or data validator and the project data quality objectives. Reported results may be considered to have a high degree of confidence because the method performance criteria were achieved or, alternatively, the results may be considered estimates and flagged by the lab. These flags include "J" qualifiers to indicate a reported result is estimated below the laboratory reporting limit; "UJ" qualifiers to indicate a reported non-detect result may be biased because the associated detection limits are inaccurate; and "B" qualifiers to indicate a reported result may be biased high due to blank contamination.

For the purposes of this investigation, groundwater, soil and indoor air sample results were summarized in thirty-one laboratory reports, provided by Lancaster Laboratories, and are evaluated in the sections below for usability. These samples were collected between 2008 and 2009 by Aquaterra Tech. on behalf of Sunoco Inc. and analyzed for volatile organic compounds (VOC), polyaromatic hydrocarbons (PAH), ethylene dibromide (EDB), lead, methane and wet chemistry parameters. Copies of the laboratory reports are provided in this appendix for your reference. Any analytical data, data qualifiers, and QC results provided in these reports were evaluated to determine the confidence with which this groundwater data could be used in the decision-making process. The criteria used in the data usability summary are presented in the following sections.

Data Quality Indicators

Data quality indicators (DQIs) are qualitative and quantitative measures of data quality "attributes," which are descriptors used to express various properties of analytical data. Thus, DQIs are the various measures of the individual data characteristics that collectively comprise the general, all encompassing term "data quality." Quality attributes used to assess the data usability include:

- Method selectivity/specificity
- Accuracy (bias)
- Precision
- Representativeness
- Comparability
- Completeness

These indicators, as they relate to the data collected during the site characterization, are described in more detail below.

Method Selectivity/Specificity

Method selectivity/specificity is defined as the compound type or class that can be detected by the instrument or detector. Instruments that are used to detect a compound class (i.e., hydrocarbons) are said to be selective. Instruments that are used to detect a specific element group (e.g., halogens) are said to be specific. Groundwater, soil, and indoor air samples, as well as field QC blanks, were analyzed for the following parameters using the listed selective and specified methods:

- GC/MS Volatiles via EPA Methods SW-846 5030B and SW-846 8260B,
- GC/MS PAHs in water via EPA Method SW-846 8270C,
- Ethylene Dibromide via EPA Method SW-846 8011,
- Lead via EPA Method SW-846 6010B and SW-846 6020,
- Wet Chemistry via EPA Method SM20 2540C and SM20 2540G,
- Volatiles via EPA Method TO-15 and
- Methane via EPA Method 18 modified.

Accuracy (Bias)

Accuracy is defined as the amount of agreement between the laboratory's reported concentration and the true concentration of an analyte in an environmental sample. An evaluation of accuracy provides an estimate of bias. Bias is considered to be high or low, which means that the "actual" concentration is likely lower or higher (respectively) than the laboratory result indicates. While bias direction can be estimated for data quality impacts the degree to which bias impacts the laboratory result cannot be estimated.

Indicators of accuracy include, but are not limited to, surrogate spike recoveries, laboratory control spike recoveries, matrix spike recoveries, and matrix spike duplicate recoveries. The acceptable ranges of accuracy for each of the above listed indicators are method specific and are defined within the published analytical test methods specified in the section above. For the purposes of this assessment, accuracy [or bias] was evaluated by reviewing the following indicators:

- *Sample hold times* to ensure all samples were analyzed within method specific timeframes. If hold times are exceeded, reported concentrations may be negatively biased.

- *Lab and field blank samples* to ensure no analytes were detected: if analytes were detected in blank samples, the concentrations of these analytes in the normal environmental samples may be positively biased.

- *Percent recovery of surrogate spikes* (synthetic compounds injected into each sample) to ensure that these compounds were recovered within the

range deemed acceptable by the analytic method. If surrogates are recovered below this range then concentrations reported for the target analytes may be negatively biased: likewise, if surrogates are recovered above this range then concentrations reported for the target analytes may be positively biased.

- *Percent recovery of each compound analyzed in the lab QC samples [Laboratory Control Spike (LCS) and Laboratory Control Spike Duplicate (LCSD)] and field QC samples [Matrix Spike (MS) and Matrix Spike Duplicate (MSD)]*.

  LCS and LCSD samples are samples of DI water spiked with known concentrations of the target analytes. LCS and LCSD samples are run at a rate of one per sample batch (approximately 20 samples) and are indicators of method performance. If compounds within the LCS or LCSD are recovered above or below the acceptable ranges than concentrations of those compounds may be biased in each of the normal environmental samples within the corresponding batch.

  MS and MSD samples are normal environmental samples collected at the project site and spiked with known concentrations of the target analytes. MS and MSD samples are typically run at the same frequency as LCS and LCSD samples but are indicators of potential bias based on the sampling matrix. If compounds within the MS or MSD are recovered above or below the acceptable ranges than concentrations of those compounds may be biased in each of the normal environmental samples within the corresponding batch.

Each laboratory sample delivery group was evaluated for accuracy based on the components listed above. Below is a summary of findings:

Sample Delivery Group 1090076:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- With the exceptions noted below, recoveries in MS/MSD samples were between acceptable recovery control limits.
  - Recoveries were less than the lower limit for fluorene and benzo(ghi)perylene in the MS and fluorene in the MSD for batch 08130SLA026 (corresponding to samples 5353907 - 5353917).
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.

- Recoveries of 4-bromofluorobenzene in samples 5353909 and 5353917 were less than the lower control limit.
- Recoveries of toluene in samples 5353916 and 5353917 were less than the lower control limit.
- Recovery of 4-bromofluorobenzene in sample 5353916 was greater than the upper control limit.

Sample Delivery Group 1090550:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Recoveries of nitrobenzene in samples 5356706, 5356714, 5356716 and 5356718 exceeded the upper control limits.
  - Recoveries of 2-fluorobiphenyl in samples 5356699, 5356702, 5356705-5356707, 5356714 and 5356718 exceeded the upper control limits.
  - Recoveries of toluene in samples 5356699, 5356701-5356703, 5356709-5356711, 5356714, 5356716 and 5356717 were less than the lower control limit.
  - Recoveries of 1,2-dichloroethane in samples 5356710-5356711, 5356714 and 5356716 were less than the lower control limit.
  - Recoveries of 4-bromofluorobenzene in samples 5356702 - 5356703 and 5356709 - 5356711 and 5356714 - 5356717 were less than the lower control limit.
  - Recoveries of dibromofluoromethane in samples 5356711, 5356714 and 5356716 were less than the lower control limit.

Sample Delivery Group 1091319:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Surrogate recovery for 1,2-dichloroethane, toluene and 4-bromofluorobenzene for sample 5361075 were less than the lower limit.

Sample Delivery Group 1092714:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery for dibromofluoromethane in sample 5369568 was less than the lower limit.
    - Surrogate recovery for 1,2-dichloroethane in samples 5369567 and 5369568 were less than the lower limit.
    - Surrogate recovery for toluene in samples 5369566-5369569 were less than the lower limit.
    - Surrogate recovery for 4-bromofluorobenzene in samples 5369567 and 5369568 were less than the lower limit.

Sample Delivery Group 1092715:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of toluene in samples 5369573 and 539672 were less than the lower limit.
    - Surrogate recovery of 1,2-dichloroethane in samples 5369571-5369572 were less than the lower limit.
    - Surrogate recovery of 4-bromofluorobenzene in samples 5369572-5369573 were less than the lower limit.
    - Surrogate recovery of 4-bromofluorobenzene in sample 5369571 was greater than the upper limit.

Sample Delivery Group 1092716:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.

- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1092862:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of 1,2-dichloroethane in samples 5370416-5370417 was less than the lower limit.
    - Surrogate recovery of toluene in samples 5370416-5370418 was less than the lower limit.
    - Surrogate recovery of 4-bromofluorobenzene in sample 5370417 was less than the lower limit.

Sample Delivery Group 1093507:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits with the exceptions below.
    - Surrogate recovery of toluene and 4-bromofluorobenzene in sample 5374123 was less than the lower limit.

Sample Delivery Group 1094202:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of toluene in sample 5378096 was less than the lower limit.
    - Surrogate recovery of 4-bromofluorobenzene in samples 5378095-5378096 were less than the lower limit.

Sample Delivery Group 1094907:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1094908:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1095356:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1095850:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1096046:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.

- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1096740:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1096931:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of dibromofluoromethane in samples 5394558-5394560 were less than the lower limit.
    - Surrogate recovery of 1,2-dichloroethane in samples 5394558-5394560 were less than the lower limit.
    - Surrogate recovery of toluene in samples 5394558-5394560 were less than the lower limit.
    - Surrogate recovery of 4-bromofluorobenzene in samples 5394557-5394560 were less than the lower limit.

Sample Delivery Group 1099596:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- With the exceptions noted below, recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
    - Recoveries were greater than the upper limits for pyrene and phenanthrene in the MSD for batch 08191SLB026 (corresponding to sample 5409889.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1100643:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.

- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1100865:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for EDB, lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of nitrobenzene in sample 5416341 was greater than the upper limit.

Sample Delivery Group 1101087:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- With the exceptions noted below, recoveries in MS/MSD samples, analyzed for EDB, lead, VOC and PAH parameters, were between acceptable recovery control limits.
    - Recoveries were less than the lower limits for toluene, ethylbenzene and xylene in the MS for batch P082053AA (corresponding to samples 5417526 - 5415727).
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
    - Surrogate recovery of 2-fluorobiphenyl in sample 5417522 was greater than the upper limit.

Sample Delivery Group 1101339:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- With the exceptions noted below, recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.

  - Recoveries were less than the lower limits for toluene, ethylbenzene and xylene in the MS for batch P082053AA (corresponding to samples 5418823 – 5418832).
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Surrogate recovery of 1,1,2,2-tetrachloroethane in samples 5418824 and 5418828 were greater than the upper limit.

Sample Delivery Group 1101473:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1102042:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Surrogate recoveries of nitrobenzene and 2-fluorobiphenyl in sample 5422562 were greater than the upper limit.

Sample Delivery Group 1102389:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- With the exceptions noted below, recoveries in MS/MSD samples, analyzed for EDB, lead, VOC and PAH parameters, were between acceptable recovery control limits.
  - Recoveries were greater than the upper limits for lead in the MSD for batch 082136050003A (corresponding to samples 5424682 - 5424694).
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Surrogate recovery of 1,1,2,2-tetrachloroethane in samples 5424688 and 5424691-5424692 were greater than the upper limit.

- Surrogate recoveries of nitrobenzene, 2-fluorobiphenyl and terphenyl for sample 5424693 are greater than the upper limits.

Sample Delivery Group 1102390:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for EDB, lead, VOC and PAH parameters, were between acceptable recovery control limits.
- With the exceptions noted below, surrogate recoveries were between acceptable recovery control limits.
  - Surrogate recovery of nitrobenzene in samples 5424702 and 5424705 were greater than the upper limit.
  - Surrogate recovery of 1,1,2,2-tetrachloroethane in sample 5424713 was greater than the upper limit.

Sample Delivery Group 1102391:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1103058:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- Recoveries in MS/MSD samples, analyzed for lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1104407:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- With the exceptions noted below, recoveries in LCS/LCSD samples were between acceptable recovery control limits.
  - Recoveries were greater than the upper limits for phenanthrene in the LCSD for batch 08221WAA026 (corresponding to samples 5435927 - 5435928).

- Recoveries in MS/MSD samples, analyzed for EDB, lead, VOC and PAH parameters, were between acceptable recovery control limits.
- Surrogate recoveries were between acceptable recovery control limits.

Sample Delivery Group 1142359:

- Samples were analyzed within sample hold times.
- One trip blank and no field blanks were submitted for analysis. Target compounds weren't detected above the LOQ in the trip blank.
- Target compounds weren't detected above the LOQ in the lab blank.
- Recoveries in LCS/LCSD samples were between acceptable recovery control limits.
- MS/MSD samples were not prepared or analyzed for these air samples.
- Surrogate analyses were not performed on air samples.

Sample Delivery Group 1148395:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- With the exceptions noted below, recoveries in LCS/LCSD samples were between acceptable recovery control limits.
    - Recoveries were greater than the upper limits for 1,4-dioxane and 2-hexanone in the LCS/LCSD for batch C0916730AA (corresponding to samples 5695000 - 5695001).
    - Recoveries were less than the lower limits for vinyl acetate in the LCS/LCSD for batch C0916730AA (corresponding to samples 5695000 - 5695001).
- MS/MSD samples were not prepared or analyzed for these air samples.
- Surrogate analyses were not performed on air samples.

Sample Delivery Group 1148396:

- Samples were analyzed within sample hold times.
- Trip and field blanks weren't submitted for analysis and can't be evaluated.
- Target compounds weren't detected above the LOQ in the lab blank.
- With the exceptions noted below, recoveries in LCS/LCSD samples were between acceptable recovery control limits.
    - Recoveries were greater than the upper limits for 1,4-dioxane and 2-hexanone in the LCS/LCSD for batch C0916730AA (corresponding to samples 5695002 - 5695004) and for batch C0916730AB (corresponding to sample 5695005).
    - Recoveries were less than the lower limits for vinyl acetate in the LCS/LCSD for batch C0916730AB (corresponding to samples 5695005).
- MS/MSD samples were not prepared or analyzed for these air samples.
- Surrogate analyses were not performed on air samples.

Precision

Precision is defined as the ability to reproduce analytical results and is the measure of variability between individual sample measurements under prescribed conditions. Precision is assessed by the analysis of duplicate samples and expressed in terms of relative percent difference (RPD). For this project, analytical variability was measured as the relative percent difference (RPD) between 1) analytical laboratory duplicates (LCS and LCSD), and 2) the matrix spike (MS) and matrix spike duplicate (MSD). Field duplicate samples are not required under the sampling guidelines and were not collected.

Each laboratory sample delivery group was evaluated for precision based on the components listed above. Below is a summary of findings:

Sample Delivery Group 1090076:

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
  - Pyrene, fluorene, phenanthrene, anthracene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene and benzo(g,h,i)perylene in batch 08130SLA026 (corresponding to samples 5353907 – 5353917).
  - Lead in batch 081306150002A (corresponding to samples 5353907 – 5353917).

Sample Delivery Group 1090550:

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
  - Lead in batch 081356150001A (corresponding to sample 5356718).

Sample Delivery Group 1091319:

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
  - Lead in batch 081376150002A (corresponding to sample 5361075).

Sample Delivery Group 1092714:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1092715:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1092716:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1092862:

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the exceptions noted below.
    - Fluorene and phenanthrene in batch 08149SLE026 (corresponding to samples 5370416 – 5370418)

Sample Delivery Group 1093507:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1094202:

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
    - Lead in batch 081566150002A (corresponding to samples 5378093 – 5378096).

Sample Delivery Group 1094907:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1094908:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1095356:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1095850:

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.

- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
    - Lead in batch 081706150003A (corresponding to sample 5388263).

Sample Delivery Group 1096046:

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method with the following exceptions:
    - Lead in batch 081706150003A (corresponding to sample 5389508).

Sample Delivery Group 1096740:

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
    - Lead in batch 081716150003A (corresponding to sample 5393378).

Sample Delivery Group 1096931:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1099596:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1100643:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1100865:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1101087:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1101339:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1101473:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1102042:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1102389:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1102309:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1102391:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1103058:

- The RPDs calculated and reported by the lab between the LCS/LCSD are within the maximum allowable by the analytical method.
- The RPDs calculated and reported by the lab between the MS/MSD are within the maximum allowable by the analytical method, with the following exceptions:
  - Lead in batch 082146050002A (corresponding to samples 5428282 – 5428285).

Sample Delivery Group 1104407:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1142359:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1148395:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Sample Delivery Group 1148396:

- The RPDs calculated and reported by the lab between the LCS/LCSD and MS/MSD are within the maximum allowable by the analytical method.

Representativeness

Representativeness is the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter most concerned with the proper design of the sampling program. The representativeness criteria may be satisfied by making certain the sampling locations are selected properly and that a sufficient number of samples are collected to fulfill program objectives.

Groundwater, surface water and indoor air samples were collected from locations biased to potential source areas and/or sensitive receptors (surface water bodies, occupied buildings, residential properties). The compounds analyzed in groundwater and soil samples include the compounds currently identified in the Pennsylvania Corrective Action Process (CAP) Regulation Amendments effective December 1, 2001; provided in Chapter VI, Section E of PADEP's Closure Requirements for Underground Storage Tank Systems (with exception for the waste oil parameters since waste oil is only stored in small tanks within the facility maintenance garages). These compounds are the same as those listed for groundwater in the Current Conditions Report (Langan, 2004). Air samples were analyzed for volatile compounds using the EPA TO-15 method.

The data collected during this investigation is considered representative of groundwater, soil and air in AOI 8 based on the distribution of the monitoring wells, soil borings and air sampling locations within the sampling program, the frequency of sample collection, and the suite of parameters analyzed.

Comparability

Comparability is the degree to which data from one study can be compared with data from other similar studies, reference values (such as background), reference materials, and screening values. This goal was achieved by using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units. The sample collection methods used were based on PADEP's guidelines summarized in the Groundwater Monitoring Guidance Manual dated December 1, 2001 and the Groundwater Sampling and Analysis Plan, dated January 17, 2008. The analytical methods used are EPA solid waste methods or Standard Methods.

Based on this data quality analysis the data are considered comparable to other groundwater, soil and air data collected as part of other sampling programs.

Completeness

Completeness is defined as the percentage of usable data in the total data population generated. Completeness was calculated for each compound where data were qualified as estimated or rejected and for compounds that were affected by blank contamination. Completeness is determined as the difference between the total

number of data points and the number of data points qualified divided by the total number of data points.

For compounds analyzed in soil [with exception of ethylene dibromide] greater than 95% percent of the data is considered usable. The remaining 5% is considered unusable because, due to matrix interference, the samples were diluted to the point that the laboratory reporting limits were elevated above the corresponding soil screening criteria (PADEP Soil MSCs) and no concentration was detected. Specifically, MTBE in samples N-109_1.0-2.0 and N-126_1.0-2.0; benzene in samples N-109_1.0-2.0, N-122_1.0-2.0, and N-126_1.0-2.0; and 1,2-dichloroethane in samples N-109_1.0-2.0, N-122_1.0-2.0, and N-126_1.0-2.0 are not considered usable for the purposes of characterization and delineation. Similarly, due to matrix interference, ethylene dibromide is also considered unusable in any sample because the laboratory reporting limits were elevated above the PADEP Soil MSC.

For compounds analyzed in groundwater [with exception of chrysene] greater than 92% percent of the data is considered usable. The remaining 8% is considered unusable because, due to matrix interference, the samples were diluted to the point that the laboratory reporting limits were elevated above the corresponding groundwater screening criteria (PADEP GW MSCs) and no concentration was detected. Specifically, 1,2-dichloroethane in samples N-23, N-34, N-35, N-58, N-61, N-119, N-133 and PZ-506; benzene in samples N-23, N-34, N-35, N-58, N-61 and PZ-506; and naphthalene in sample N-36. Similarly, due to matrix interference, chrysene is also considered unusable in any sample because the laboratory reporting limits were elevated above the PADEP Soil MSC.

One hundred percent of the air data is considered usable, with select concentrations considered biased and, therefore, estimated. The number of samples planned was expected to provide sufficient data to satisfy the objective defined in the Current Conditions Report (Langan, 2004). Had the initial results not met QC requirements the volume of samples collected was sufficient to reanalyze samples as necessary.

Summary and Conclusions

For the purposes of this investigation, sample results were summarized in thirty one sample delivery groups, provided by Lancaster Laboratories, and are evaluated in the sections above for usability. Copies of the laboratory reports are provided in this appendix for your reference.

The laboratory performed quality assurance and quality control (QA/QC) analyses, including laboratory control spikes and laboratory control spike duplicates, matrix spikes and matrix spike duplicates, surrogate spikes, method blanks and QA/QC checks such as GC/MS instrument tuning and mass calibration, as appropriate. Laboratory QA/QC summaries were completed by the laboratory and provided in each data package,

attached. The analytical data, data qualifiers, and QC results provided in these reports were evaluated to determine the confidence with which this groundwater, soil and air data could be used in the decision-making process.

Data quality indicators (DQIs) are qualitative and quantitative measures of data quality "attributes," which are descriptors used to express various properties of analytical data. Thus, DQIs are the various measures of the individual data characteristics that collectively comprise the general, all encompassing term "data quality." Quality attributes used to assess the data usability include:

- Method selectivity/specificity
- Accuracy (bias)
- Precision
- Representativeness
- Comparability
- Completeness

Based on evaluation of these indicators the groundwater, soil and air data collected during this investigation is considered usable with the exception of those described above for characterizing the site, identifying compounds of concern, and delineating potential impacts. As detailed in the sections above, few concentrations should be considered as biased because LCS/LCSD, MS/MSD and surrogate recoveries were beyond acceptable control limits. Reviews of the biased concentrations show that it is unlikely that any of the concentrations would have exceeded the standard had the bias not occurred.

Where the LCS/LCSD and MS/MSD recoveries were less than the lower recovery control limit the reported values should be considered as estimated low. Where the recoveries were greater than the upper recovery control limit the reported values should be considered as estimated high. The corresponding data are considered usable but should be considered slightly higher or lower in concentration than representative of the site and time collected.